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demonstration of this theorem by drawing from the vertex of the right triangle a perpendicular to the hypotenuse and then suitably manipulating the proportions yielded by the similar triangles. This proof was unknown in Europe until it was rediscovered by the English mathematician, John Wallis.

Among Arabic authors the earliest proof, for the case of the isosceles right triangle, was given by Alchwarizmi, who lived in the early part of the 9th century. It is the same as that in Plato's *Meno*. The Persian mathematician, Nasir Eddin, who flourished during the early part of the 13th century, gave a new proof, which required the consideration of eight special cases.\* Until six years ago this proof was attributed to more recent writers.

The theorem of Pythagoras has received several nicknames. In European universities of the Middle Ages it was called "magister matheseos," because examinations for the degree of A. M. (when held at all) appear usually not to have extended beyond this theorem, which, with its converse, is the last in the first book of Euclid. The name, "pons asinorum," has sometimes been applied to it, though usually this is the sobriquet for *Euclid*, I., 5. Some Arabic writers, Behâ Eddin for instance, call the Pythagorean theorem, "figure of the bride." Curiously enough, this romantic appellation appears to have originated from a mis-translation of the Greek word *νύμφη*, applied to the theorem by a Byzantine writer of the 13th century. This Greek word admits of two meanings, "bride" and "winged insect." The figure of the right triangle with the three squares suggests an insect, but Behâ Eddin apparently translated the word as "bride."†

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\*See H. Suter in *Bibliotheca Mathematica*, 1892, pages 3 and 4.

†See P. Tannery in *L'Intermédiaire des Mathématiciens*, 1894, Vol. I, page 254.

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## DEPARTMENTS.

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### SOLUTIONS OF PROBLEMS.

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#### ARITHMETIC.

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106. Proposed by ELMER SCHUYLER, High Bridge, N. J.

What is the amount of \$1000 at compound interest for three years, at 6%, if it be compounded every instant?

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Science and Mathematics, Chester High School, Chester, Pa., and J. OWEN MAHONEY, B. E., M. Sc., Instructor in Mathematics, Carthage High School, Carthage, Texas.

Let  $A$  = amount,  $P$  = principal,  $r$  = rate,  $n$  = number of years,  $q$  = number of times interest is payable a year.

Then  $A = P[1 + (r/q)]^{qn}$ . Let  $q = rx$ .

∴  $A = P[1 + (1/x)^{nrx}] = P\{[1 + (1/x)]^x\}^{rn} = Pe^{rn}$  when  $x$  is infinite.

∴  $A = 1000e^{.18} = 1000 \times 1.19705 = \$1197.05$ .

II. Solution by WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass.; J. D. CRAIG, Frankfort, Ky.; and COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.

Let  $A$  be the amount of  $P$  dollars for  $n$  years at  $r$  per cent. payable  $q$  times a year. Then  $A = P[1 + (r/q)]^{nq} =$

$$P \left[ 1 + nr + \frac{n^2 r^2}{1.2} - \frac{nr^2}{1.2.q} + \frac{n^3 r^3}{1.2.3} + \frac{2n}{1.2.3q^2} - \frac{3n}{1.2.3.q} + \frac{n^4 r^4}{1.2.3.4} + \dots \right].$$

Now if interest is to be compounded every instant,  $q$  is infinite and hence all terms in this series containing  $q$  will vanish, and we have

$$A = P \left[ 1 + nr + \frac{n^2 r^2}{1.2} + \frac{n^3 r^3}{1.2.3} + \frac{n^4 r^4}{1.2.3.4} + \dots \right] = P e^{nr}.$$

$$\therefore A = \$1000(2.71828)^{.18} = \$1197.462 +.$$

III. Solution by D. G. DORRANCE, Jr., Camden, N. Y.

The formula for the amount of ( $a$ ) dollars for ( $n$ ) years at  $r\%$  interest compounded every  $x$ th part of a year is

$$a \left( 1 + \frac{r}{x} \right)^{nx}$$

which expanded by the Binomial Theorem becomes

$$a \left( 1 + nx \frac{r}{x} + \frac{nx(nx-1)}{1.2} \frac{r^2}{x^2} + \frac{nx(nx-1)(nx-2)}{1.2.3} \frac{r^3}{x^3} + \text{etc.} \right)$$

which, when  $x$  is made infinitely large, becomes

$$a \left( 1 + nr + \frac{n^2 r^2}{1.2} + \frac{n^3 r^3}{1.2.3} + \frac{n^4 r^4}{1.2.3.4} + \frac{n^5 r^5}{1.2.3.4.5} + \text{etc.} \right).$$

Make  $a = \$1000$ ,  $n = 3$ , and  $r = .06$ , and the above becomes

$$\begin{aligned} & \$1000(1 + .18 + .0162 + .000972 + .00004374 + .00000157464 + \text{etc.}) \\ & = \$1000(1.19721731464 +) = \$1197.21731464 +, \text{ the required amount.} \end{aligned}$$

Also solved by CHAS. C. CROSS, and ALOIS F. KOVARIK.

## ALGEBRA.

91. Proposed by NELSON S. RORAY, Professor of Mathematics, South Jersey Institute, Bridgeton, N. J.

Solve the following without making use of the determinant notation, and prove that the results obtained are the roots.

$$\begin{aligned} 10x - 2y + 4z &= 5, \\ 3x + 5y - 3z &= 7, \\ x + 3y - 2z &= 2. \end{aligned}$$